MASTERJEE CLASSES

BRAIN MAP

CLASS XII

RAY OPTICS AND OPTICAL INSTRUMENTS

APPLICATIONS OF TIR

- Fiber optics communication
- Medical endoscopy
- Periscope (Using prism)
- Sparkling of diamond

TOTAL INTERNAL REFLECTION

TIR conditions

- Light must travel from denser to rarer.
- Incident angle $i >$ critical angle i_c

Relation between μ and i_c: $\mu = \dfrac{1}{\sin i_c}$

REFRACTION OF LIGHT

Snell's law: When light travels from medium a to medium b, ${}^a\mu_b = \dfrac{\mu_b}{\mu_a} = \dfrac{\sin i}{\sin r}$

Refractive index,

$$\mu = \frac{\text{velocity of light in vacuum}}{\text{velocity of light in medium}} = \frac{c}{v}$$

Real and apparent depth

$$\mu = \frac{\text{real depth}(x)}{\text{apparent depth }(y)}$$

REFLECTION OF LIGHT

According to the laws of reflection, $\angle i = \angle r$

If a plane mirror is rotated by an angle θ, the reflected rays rotates by an angle 2θ.

SIMPLE MICROSCOPE

Magnifying power

For final image is formed at D (least distance) $M = 1 + \dfrac{D}{f}$

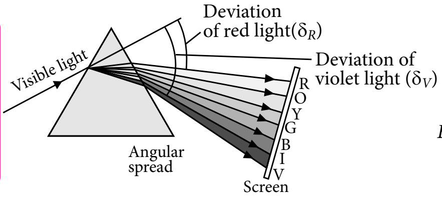
For final image formed at infinity

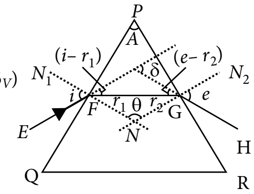
$$M = \frac{D}{f}$$

REFLECTING TELESCOPE

Magnifying power

$$M = \frac{f_o}{f_e} = \frac{R/2}{f_e}$$





REFRACTION THROUGH PRISM

Relation between μ and δ_m

$$\mu = \frac{\sin\dfrac{A+\delta_m}{2}}{\sin\dfrac{A}{2}}$$

(where, δ_m = angle of minimum deviation, A = angle of prism)

or $\delta = (\mu - 1)A$ (Prism of small angle)

Angular dispersion

$$= \delta_V - \delta_R = (\mu_V - \mu_R)A$$

Dispersive power,

$$\omega = \frac{\delta_V - \delta_R}{\delta} = \frac{\mu_V - \mu_R}{\mu - 1}$$

Mean deviation, $\delta = \dfrac{\delta_V + \delta_R}{2}$

RAY OPTICS

OPTICAL INSTRUMENTS

TELESCOPE

Astronomical telescope

For final image formed at D (least distance) $M = \dfrac{f_o}{f_e}\left(1 + \dfrac{f_e}{D}\right)$

In normal adjustment, image formed at infinity $M = f_o / f_e$

POWER OF LENSES

Power of lens: $P = \dfrac{1}{f\text{ (in m)}}$

Combination of lenses:

Power: $P = P_1 + P_2 - dP_1P_2$

(d = small separation between the lenses)

For $d = 0$ (lenses in contact)

Power: $P = P_1 + P_2 + P_3 + ...$

THIN SPHERICAL LENS

Thin lens formula: $\dfrac{1}{v} - \dfrac{1}{u} = \dfrac{1}{f}$

Magnification: $m = \dfrac{v}{u} = \dfrac{h_i}{h_o}$

REFRACTION BY SPHERICAL SURFACE

Relation between object distance (u), image distance (v) and refractive index (μ)

$$\frac{\mu_{\text{denser}}}{v} - \frac{\mu_{\text{rarer}}}{u} = \frac{\mu_{\text{denser}} - \mu_{\text{rarer}}}{R}$$

(Holds for any curved spherical surface.)

Lens maker's formula

$$\frac{1}{f} = (\mu - 1)\left[\frac{1}{R_1} - \frac{1}{R_2}\right]$$

REFLECTION BY SPHERICAL MIRRORS

Mirror formula, $\dfrac{1}{u} + \dfrac{1}{v} = \dfrac{1}{f} = \dfrac{2}{R}$

Magnification, $m = -\dfrac{v}{u} = \dfrac{h_i}{h_o}$

COMPOUND MICROSCOPE

Magnifying power, $M = m_o \times m_e$

For final image formed at D (least distance) $M = \dfrac{L}{f_o}\left(1 + \dfrac{D}{f_e}\right)$

For final image formed at infinity

$$M = \frac{L}{f_o} \cdot \frac{D}{f_e}$$

TERRESTRIAL TELESCOPE

For normal adjustment $M = \dfrac{f_o}{f_e}$

Distance between objective and eyepiece $d = f_o + 4f + f_e$